Graduate Studies
Department of Physiology
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Sympathetic and Sensory Neuron Regulation of Blood Vessels: Changes in Hypertension

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The heart and blood vessels are innervated by autonomic and sensory nerves. In the autonomic nervous system the final neurons that innervate end organs are grouped in autonomic ganglia. Ganglionic neurons are one of the important sites for integration and coordination of efferent and sensory synaptic signals that regulate the cardiovascular system. My research interests are in the properties of sympathetic ganglia and the relationship of the characteristics of individual neurons to the regulation of the cardiovascular system. We also study the interactions between the spinal sensory neurons and sympathetic neurons that innervate the same tissues. To understand how the sympathetic ganglia regulate and coordinate vascular and cardiac function we are asking the following questions:

- What is the anatomical organization of the sympathetic ganglia innervating the heart and the abdominal blood vessels?
- How does the innervation of arteries differ from the innervation of veins?
- What are the events in neuromuscular transmission in arteries and veins?
- What alterations occur in sympathetic ganglia in hypertension?
- Is oxidative stress important in the changes observed in sympathetic nerves in hypertension?
- How is the expression and function of norepinephrine transporter altered in hypertension?

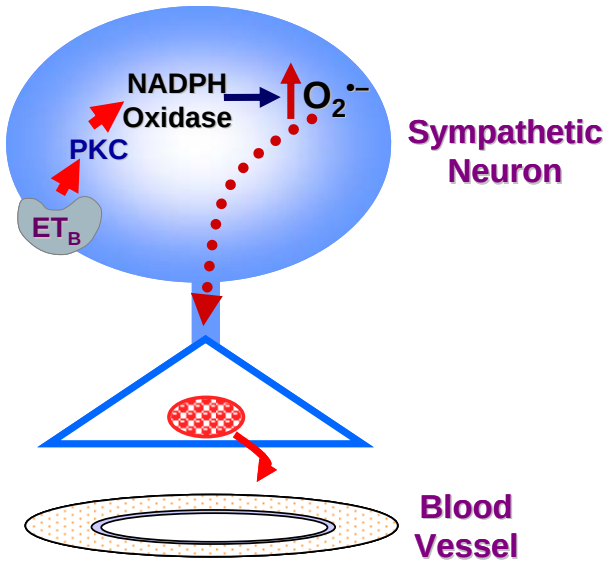

Fig. 1. Diagram of oxidative pathways in a sympathetic neuron that innervates a blood vessel. Generation of superoxide anion ($O_2^{\bullet-}$) by stimulation of endothelin receptors (ET_B) in the neurons may influence the neuron and alter release of

We have found that some of the functional properties of sympathetic neurons are altered in hypertensive animals. For example, sympathetic ganglia of hypertensive rats have elevated levels of a so-called "reactive oxygen species" superoxide anion ($O_2^{\bullet-}$). This molecule is generated by the enzyme NADPH Oxidase which we have demonstrated is found in sympathetic ganglion neurons. Production of too much of this molecule can overwhelm the cells and cause "oxidative stress." $O_2^{\bullet-}$ may also function as an intracellular signaling molecule and cause physiological changes in the functions of neurons which may change the amounts of neurotransmitters released. These kinds of changes could alter the constriction of arteries and veins and the contractions of the heart resulting in increases in blood pressure. We are investigating when these changes are physiological and when they become pathological resulting in hypertension.

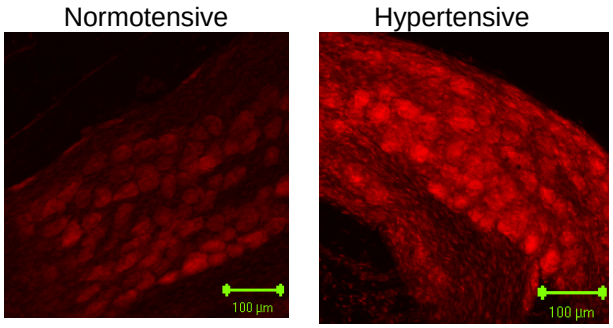

Fig. 2. Comparison of $O_2^{\bullet-}$ levels in sympathetic ganglia in normotensive and hypertensive rats. Elevated levels of this reactive oxygen molecule in hypertensive neurons may result in the alterations of function responsible for increased blood pressure.

Understanding the properties of sympathetic and sensory neurons and how they change in diseases such as hypertension will provide us ways to design therapies to prevent and treat these widespread and devastating diseases.